ASME B31.3 Chemical Plant and Petroleum Refinery Piping Code (2004) Requirements

PRESSFIT® SYSTEM FOR CARBON AND STAINLESS STEEL (VIC-PRESS 316™ AND VIC-PRESS 304™) PIPE

The American Society of Mechanical Engineers (ASME) established the B31 Pressure Piping Code Committees to promote safety in pressure piping design and construction through published engineering criteria. The basic consideration of the Codes is safety; however, the Codes are not designed to replace competent engineering design or judgment. Most importantly, the Codes do not "approve," "rate," or "endorse" any items of construction, proprietary devices, or activity. The Codes do not put a limit on conservatism and, conversely, the Codes also allow for designs that are capable of more rigorous engineering analysis which justifies less conservative designs. A final point of importance is that the Codes strive to keep abreast of all current technologies regarding improvements to materials, fabrication, and any other new developments in the piping industry. They are not intended to limit the introduction of new products. Numerous sections of the B31 Codes provide the necessary guidelines to analyze new or nontraditional products so that sound engineering judgments can be made regarding Code conformance.

The Victaulic Carbon and Stainless Steel Pressfit Systems (Type 316 and Vic-Press 304) may be used on ASME B31 applications. ASME B31.3 permits the use of mechanical joints as a method for joining pipe. The Pressfit System may be qualified for use based upon Paragraph 304.7.2 (a), which states:

> *"Extensive, successful service experience under comparable conditions with similarly proportioned components of the same or like material."*

The Pressfit Systems have a long history of past successful service both in the country of its origin (Germany) and in the United States.

In addition to the above sections, Pressfit products also may be permitted under Paragraph 304.7.2, which permits unlisted components provided that engineering calculations or tests have demonstrated that the joint is safe for the operating conditions. Numerous tests have been conducted by independent evaluation agencies verifying the use of Pressfit products within our published parameters.

Pressfit fittings are made from special, high tolerance tubing which meets the minimum physical and chemical requirements of ASTM A-135, Grade A (carbon steel), ASTM A-312, Type 316L or Type 304L (stainless steel). Commercially available carbon steel Schedule 5 pipe for use with the carbon steel Pressfit System also meets the requirements of ASTM A-135, Grade A. The Victaulic Approved Pressfit stainless steel Schedule 5 pipe also meets ASTM A-312, Type 316L/304L. These piping materials may be used on ASME B31.3 applications in excess of the 300 psi working pressure to which we limit the Pressfit Systems. The ASME B31.3, Section 304.1 calculations show that the maximum calculated pressure rating for Schedule 5 ASTM A-135 Grade A carbon steel, Schedule 5 ASTM A-312, Type 316L and Type 304L stainless steel pipe is in excess of our 300 psi maximum joint rating. Therefore, the **300 psi** rating is within the design requirements of ASME B31.3.

The **300 psi Pressfit System working pressure** was established through extensive testing in our Engineering Laboratory and provides a nominal 3:1 factor of safety in all sizes and styles. Additional testing also was conducted in order to gain Underwriters Laboratories (UL) Listing and Factory Mutual (FM) Approval for use in fire protection systems. The proof testing data on file meets the requirements of ASME Section VIII, UG-101, *Proof Tests to Establish Maximum Allowable Working Pressure, for ASME B31.3, 304.7.2 (c)*.

UL test standard 213 requirements stipulate a 5:1 successful pressure test of 875 psi in order to be Listed for 175 psi fire protection service. Carbon steel Pressfit fittings have passed all required tests and are Listed by UL for 175 psi in all sizes and configurations.

The UL testing data meets the requirements of ASME Section VIII UG-101.l *Brittle-Coating Test Procedure*. As stated above, carbon steel Pressfit fittings meet ASTM A-135 material requirements with a minimum specified ultimate tensile of 48 KSI and a minimum specified yield of 30 KSI. The resulting ratio of yield to tensile is .625, which is equal to the minimum .625 ratio required by Section UG-101.a.2.a to base the proof testing on yield and utilize the formula stipulated in Section UG-101.l.2.b.2 to establish the maximum allowable working pressure (P) of the tested part.

$$P = .4H$$

The Hydrostatic Test Pressure (H), is the pressure at which point the test was stopped. For carbon steel Pressfit products, this pressure, as stated for UL testing purposes, is 875 psi. Therefore, the B31.3 working pressure for the carbon steel Pressfit System can be established to be 350 psi (.4 x 875). However, Victaulic conservatively states **300 psi** as the maximum working pressure for carbon steel Pressfit fittings.

Stainless steel Pressfit products have not been UL tested. However, as evidenced by the ASME B31.3, 304.1 calculations and our extensive in-house qualification testing, the stainless steel performance has proven to be equal or superior to the carbon steel and would provide, at minimum, an equal Section VIII, UG-101 working pressure.

The conformance of the Pressfit Systems to the B31.3 standard should also be reviewed by the piping system designer for the type of B31.3 application. Our Pressfit products will be acceptable on B31.3 applications that are within the scope of the Victaulic published performance limitations. Services such as raw, intermediate and finish chemicals, petroleum products, non-combustible gases, air, water, fluidized solids, refrigerants and other fluids are permitted provided that the system temperature is within our published temperature range, the chemicals are compatible with the Pressfit o-rings and the system pressure is equal to or less than the published working pressure of the Pressfit System (300 psi).

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CALCULATIONS

Carbon Steel Pressfit Calculations	Stainless Steel Vic-Press 316/304 Pressfit Calculations
ASME B31.3 Equation #3a	ASME B31.3 Equation #3a
$P = \frac{2SE(t_m - A)}{D_o - 2y(t_m - A)}$	$P = \frac{2SE(t_m - A)}{D_o - 2y(t_m - A)}$
Where:	Where:
P = Internal Design Pressure (psi)	P = Internal Design Pressure (psi)
t_m = Minimum Wall Thickness	t_m = Minimum Wall Thickness
= 0.065" – 12.5% = 0.057" (ASTM A-135)	= 0.065" – 12.5% = 0.057" (ASTM A-312)
D_o = Pipe Outside Diameter (Maximum) (ASTM A-135)	D_o = Pipe Outside Diameter (Maximum) (ASTM A-312 per ASTM A-530)
¾" = 1.050" x 1.01 = 1.061"	¾" = 1.050" + 0.016 = 1.066"
1" = 1.315" x 1.01 = 1.328"	1" = 1.315" + 0.016 = 1.331"
1 ¼" = 1.660" x 1.01 = 1.677"	1 ¼" = 1.660" + 0.016 = 1.676"
1 ½" = 1.900" x 1.01 = 1.919"	1 ½" = 1.900" + 0.016 = 1.916"
2" = 2.375" x 1.01 = 2.399"	2" = 2.375" + 0.031 = 2.406"
y = Coefficient from Table 304.1.1 = 0.4	y = Coefficient from Table 304.1.1 = 0.4
SE = Maximum Allowable Material Stress (Table A-1) = 13.6 KSI	SE = Maximum Allowable Material Stress at 200°F (Table A-1) = 14.2 KSI
A = 0 (for plain end pipe)	A = 0 (for plain end pipe)
$P = \frac{2(13,600)(0.057 - 0)}{D_o - 2(0.4)(0.057) - 0)}$	$P = \frac{2(14,200)(0.057 - 0)}{D_o - 2(0.4)(0.057) - 0)}$
¾": $P = \frac{1550.4}{1.061 - 0.046}$ = 1527.5 *PSI*	¾": $P = \frac{1618.8}{1.066 - 0.046}$ = 1587.1 *PSI*
1": $P = \frac{1550.4}{1.328 - 0.046}$ = 1209.4 *PSI*	1": $P = \frac{1618.8}{1.331 - 0.046}$ = 1259.8 *PSI*
1 ¼": $P = \frac{1550.4}{1.677 - 0.046}$ = 950.6 *PSI*	1 ¼": $P = \frac{1618.8}{1.676 - 0.046}$ = 993.1 *PSI*
1 ½": $P = \frac{1550.4}{1.919 - 0.046}$ = 827.8 *PSI*	1 ½": $P = \frac{1618.8}{1.916 - 0.046}$ = 838.8 *PSI*
2": $P = \frac{1550.4}{2.399 - 0.046}$ = 658.9 *PSI*	2": $P = \frac{1618.8}{2.406 - 0.046}$ = 685.9 *PSI*

US & WORLD HEADQUARTERS

P.O. Box 31
Easton, PA 18044-0031 USA

4901 Kesslersville Road
Easton, PA 18040 USA

1-800-PICK-VIC (1-800-742-5842)
1-610-559-3300
1-610-250-8817 (fax)
pickvic@victaulic.com

www.victaulic.com

CANADA

905-884-7444
905-884-9774 (fax)
viccanada@victaulic.com

EUROPE

32-9-381-15-00
32-9-380-44-38 (fax)
viceuro@victaulic.be

UNITED KINGDOM

44 (0) 1438741100
44 (0) 1438313883 (fax)
viceuro@victaulic.be

CENTRAL AND SOUTH AMERICA

1-610-559-3300
1-610-559-3608 (fax)
vical@victaulic.com

ASIA PACIFIC

86-21-54253300
86-21-54253671 (fax)
vicap@victaulic.com

MIDDLE EAST

971-4-883-88-70
971-4-883-88-60 (fax)

WCAS-6M8PEG

UPDATED 6/2006
12.08 2082 REV B